

CLAIMS:

1. A fuel cell assembly comprising:
a plurality of separate elements;
5 at least one groove network extending through the fuel cell assembly and including at least one filling port for the groove network; and
a seal within each groove network that has been formed in place after assembly of said separate elements, wherein the seal provides a barrier between at least two of said separate elements to define a chamber for a fluid
10 for operation of the fuel cell.
2. A fuel cell assembly as claimed in claim 1, wherein the groove network comprises a plurality of closed groove segments, each of which comprises at least a groove segment in one of said separate elements that
15 faces and is closed by another of said separate elements, thereby to form said closed groove segments.
3. A fuel cell assembly as claimed in claim 2, wherein at least some of said closed groove segments each comprise a first groove segment in one of
20 said separate elements facing a second groove segment in another of said separate elements.
4. A fuel cell assembly as claimed in claim 2, which comprises a plurality of individual fuel cells.
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5. A fuel cell assembly as claimed in claim 4, wherein each fuel cell comprises a plurality of separate elements, each of which includes a connection aperture, whereby the connection apertures form a connection duct of the groove network extending through each fuel cell, and wherein the
30 connection ducts of individual fuel cells are interconnected and are connected to said at least one filling port, whereby the groove network extends through a plurality of fuel cells, to enable a seal for all of the fuel cells to be formed substantially simultaneously and wherein the seal has been formed by injection

of a liquid elastomeric seal material and subsequent curing of the elastomeric seal material.

6. A fuel cell assembly as claimed in claim 5, which comprises a
5 plurality of proton exchange membrane fuel cells, each of which comprises an anode flow field plate, a cathode flow field plate, a membrane electrode assembly including a proton exchange membrane and located between the anode and cathode flow field plates, a first gas diffusion layer between the anode flow field plate and the membrane electrode assembly and a second gas
10 diffusion layer between the membrane electrode assembly and the cathode flow field plate, wherein at least the anode and cathode flow field plates define apertures for forming, with apertures of other fuel cells, ducts for fuel, an oxidant and a coolant.

15 7. A fuel cell assembly as claimed in claim 6, wherein each anode flow field plate and each cathode flow field plate include recesses to accommodate the first and second gas diffusion layers, and wherein portions of the anode and the cathode flow field plates of each fuel cell not separated by the membrane electrode assembly are separated by an insulator, whereby
20 compression of the first and second gas diffusion layers is determined by the dimensions of said recesses.

8. A fuel cell assembly as claimed in claim 6, wherein facing
surfaces of each pair of anode and cathode flow field plates have substantially
25 flat opposed faces, and the gas diffusion layer and membrane extend substantially to edges of the flow field plates.

9. A fuel cell assembly as claimed in claim 8, wherein surfaces of
the anode and cathode flow field plates include grooves for the elastomeric
30 seal material that fills the grooves and penetrates the gas diffusion layers, to form a seal with the membrane.

10. A fuel cell assembly as claimed in claim 9, wherein each proton exchange membrane includes a peripheral flange, and the seal material is bonded to the peripheral flanges.
- 5 11. A fuel cell assembly as claimed in claim 10, wherein each flat, opposed face of the anode and cathode flow field plates includes flow field channels for gases.
12. A fuel cell assembly as claimed in claim 10, which comprises a
10 membrane electrode assembly intended for assembly with similar membrane electrode assemblies into a larger fuel cell stack, the fuel cell assembly including, at either end thereof, end surfaces adapted for mating with end surfaces of similar membrane electrode assemblies.
- 15 13. A fuel cell assembly as claimed in claim 12, wherein at least one of said end surfaces is provided with a seal, for forming a seal with the end surface of another similar membrane electrode assembly.
14. A fuel cell assembly as claimed in claim 10, wherein each of the
20 anode and cathode flow field plates includes, at one end thereof, a first fuel aperture, a first coolant aperture and a first oxidant aperture, and at the other end thereof, a second fuel aperture, a second coolant aperture and a second oxidant aperture; wherein each of the anode and cathode flow field plates includes a first connection aperture at said one end and a second connection
25 aperture at said other end for supply of material to form said seal.
15. A fuel cell assembly as claimed in claim 14;
wherein the anode flow field plate includes on a rear face away from the membrane electrode assembly, a groove network portion including
30 groove elements that extend around the fuel and oxidant apertures and that extend only partially around the coolant apertures, thereby to enable coolant to flow between the coolant apertures across the rear face thereof, wherein a second groove network portion is provided on the front face of the anode flow

field plate and includes groove segments extending around at least the oxidant and coolant apertures, the anode flow field plate including a channel network, on the front face thereof, to distribute fuel gas over the first gas diffusion layer; and

5 wherein the cathode flow field plate includes a third groove network portion on the rear face thereof, away from the membrane electrode assembly, including groove elements that extend around the oxidant and fuel apertures and that extend only partially around the coolant apertures, thereby to enable coolant flow across the rear face thereof between the coolant
10 apertures; and wherein a fourth groove network portion, on the front face of the cathode flow field plate, includes groove segments extending around at least the fuel and coolant apertures, the cathode flow field plate including a channel network, on the front face thereof, to distribute oxidant gas over the second gas diffusion layer.

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16. A fuel cell assembly as claimed in claim 15, wherein each of the connection apertures is positioned to intersect groove segments around the coolant and fuel apertures.

20 17. A fuel cell assembly as claimed in claim 16, wherein the groove segments are dimensioned and are of a shape and size to provide substantially similar filling times, with longer groove segments being provided with larger cross sections, thereby to prevent occurrence of air pockets

25 18. A fuel cell assembly as claimed in claim 17, which includes vents extending between the groove network and at least one of the exterior of the fuel cell assembly and internal chambers within the fuel cell assembly, the vents being dimensioned to permit air to escape and being small enough to cause pressure to build up in the elastomeric material to ensure complete filling
30 of the entire groove network.

19. A fuel cell assembly as claimed in claim 18, wherein each element includes at least two connection apertures and a plurality of vents located substantially equal distance between the connection apertures thereof, for venting air during filling of the groove networks.

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20. A fuel cell assembly as claimed in claim 2, which includes an external sealing layer formed around the exterior of the fuel cell assembly and formed from the same material as said seal within each groove network, wherein connections are provided between each groove network and the
10 exterior of the fuel cell assembly and said external sealing layer and said seal within each groove network have been formed in place simultaneously.

21. A fuel cell assembly as claimed in claim 20, wherein the fuel cell assembly comprises a plurality of individual fuel cells located between two end
15 plates and wherein the external sealing layer encloses all the fuel cells and extends between the two end plates.

22. A fuel cell assembly as claimed in claim 2, which includes at least one fuel cell and, one side, a seal molded in place and adapted to abut the
20 other side of another, similar fuel cell assembly to form a chamber for coolant, whereby a plurality of said fuel cell assemblies can be assembled together to form a large fuel cell unit assembly with coolant chambers being formed between adjacent fuel cell assemblies.

25 23. A fuel cell assembly as claimed in claim 1, in which the seal comprises at least one of: an ethylene/acrylic polymer; a fluoro elastomer; and an Ethylene Propylene Terpolymer.

24. A fuel cell assembly as claimed in claim 1, in which the seal
30 comprises a flexible or rigid epoxy resin.

25. A fuel cell assembly as claimed claim 1, in which the seal comprises a thermoplastic elastomer.

26. A fuel cell assembly as claimed in claim 25, in which the thermoplastic elastomer comprises a polyester elastomer.

27. An electrochemical cell assembly comprising:
5 a plurality of separate elements;
at least one groove network extending through the electrochemical cell assembly and including at least one filling port for the groove network; and
a seal within each groove network that has been formed in place
10 after assembly of said separate elements, wherein the seal defines a barrier between at least two elements to define a chamber for a fluid for operation of the electrochemical cell assembly.